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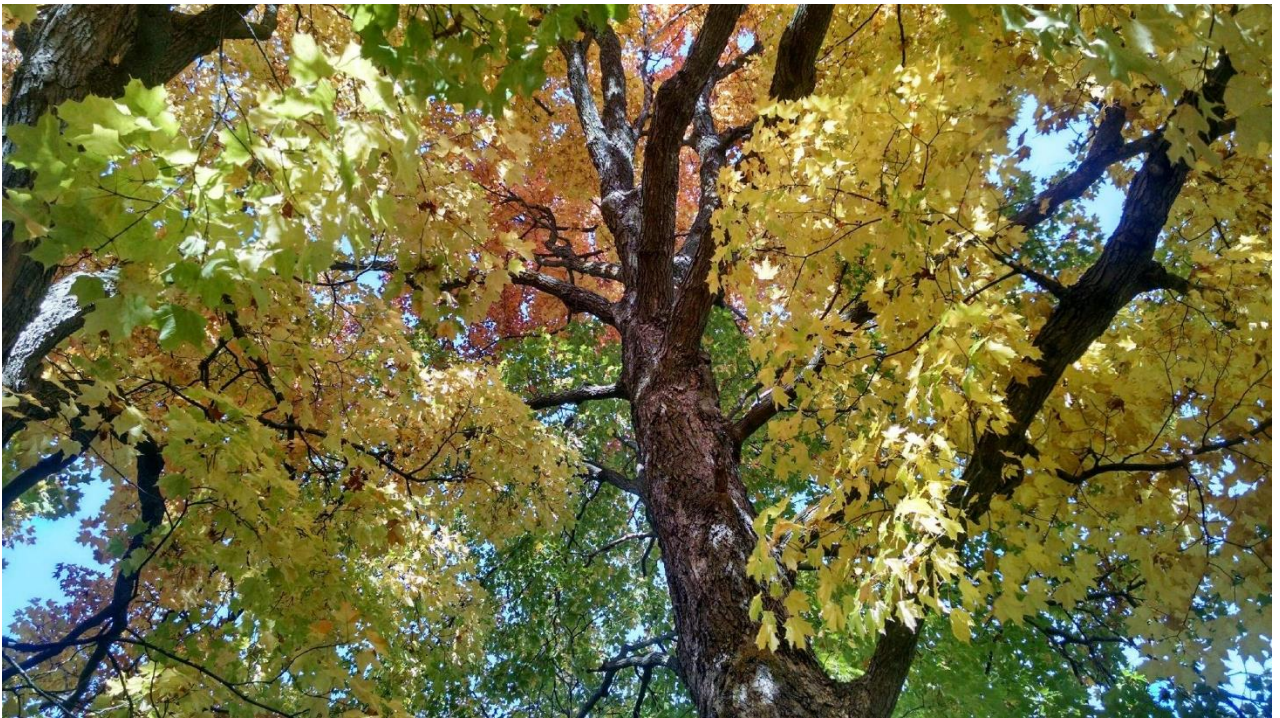


## **Vegetation Resource Report**

### **For the Fourmile Project**

### **Eagle River- Florence RD**

Chequamegon-Nicolet National Forest



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Date:  
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# Executive Summary

This report would analyze and discuss the effects of the Fourmile Project activities on forest vegetation. The Fourmile Proposed Action has the potential to modify the composition and structure of upland forest vegetation (WITHIN THIS REPORT ONLY UPLAND FOREST TYPES WOULD BE DISCUSSED, AND ANALYZED). This report considers the proposals and discusses what effects they would have on the vegetation within the project area now and in the future.

This report compares the anticipated changes in vegetation to the desired conditions given in the Chequamegon-Nicolet Forest Plan. It also identifies which alternative actions best respond to the Fourmile Project's Purpose of and Need for Action.

In comparing and analyzing the alternatives, the following are discussed:

- Vegetation Composition – measured by acres and percent of types by Management Area.
- Vegetation Age Class Distribution – measured by acres and percentages in each age class.
- Forest Plan Composition Objectives and Desired Age Class Distributions.
- Conversion of Northern Hardwood stands from even-aged to two aged or uneven-aged condition- measured in acres and percent by management area

These measures are important as they not only measure how well the action would achieve the purpose and need, but they are also important in determining movement toward or away from Forest Plan desired future conditions (DFCs).

The actions of timber harvests and planting are the key actions that would result in measurable effects to forest vegetation. Other related actions, such as site preparation, prescribed burning, and hand release of seedlings also affect forest vegetation, but in less measurable ways. All of these actions are considered in this report and the results are discussed in the context of the Forest Plan DFCs.

In preparing this analysis, the existing condition of the vegetation within the Fourmile Project Area was summarized and all expected changes were identified, by alternative. These changes were added or subtracted from the existing condition to arrive at the expected results. The results were displayed in the context of Forest Plan Management Area direction at the project, area, and forest level. With this information, it displayed which actions moved the area in the proper management direction, and to what degree. Previous, other current, and planned future activities and their potential impacts of management were considered while determining cumulative impacts.

A summary of findings are as follows:

- Alternative 2 used selection harvest and improvement harvests in northern hardwood to convert 5,433 acres to two-aged and uneven-aged stands. Alternative 1 (the no action alternative) converted no northern hardwood to two-aged or uneven-aged.
- Alternative 2 converted many acres of the Fourmile project area forest types to more closely reflect Forest Plan guidance.
- Alternative 2 reduces the stocking levels 9,639 acres of overstocked (by means of commercial thinning, selection cuts, and improvement cuts) stands within Fourmile project area on. Alternative 1 does not reduce stocking levels on any acreage.
- Alternative 2 would adjust 2,291 acres of overmature stands to a younger cohort which more closely reflects Forest Plan guidelines than Alternative 1.

# Introduction

**This report would analyze and discuss the effects of the Fourmile Project activities on forest vegetation.**

Vegetation management activities result in changes to forest composition and structure. Different types of harvests change stand density, forest types, age classes of the same forest type and age classes of trees within individual stands. Planting, site preparation, and prescribed fire, likewise, change vegetative composition and structure. The activities included in the Proposed Action are intended to move vegetative conditions in the Fourmile Project Area toward conditions desired in the Chequamegon-Nicolet Forest Plan. Throughout this document, each of the project alternatives would be analyzed and discussed in relation to the desired future conditions given in the Forest Plan.

Some respondents expressed a concern about the lack of young aspen in the project area. Aspen is a short-lived, sun-loving species that requires periodic stand replacement disturbances (usually clearcutting) in order to regenerate (Perala, D.A., 1977). Without such disturbances, aspen trees gradually die and are replaced by more long-lived shade-tolerant species, such as hardwoods, pines, or oaks. The Chequamegon-Nicolet Forest Plan gives direction on the management of aspen, both in terms of a range of desired composition and the desired age class distribution.

Some of the activities in the Fourmile Project have the potential to affect the future amount of aspen in the project area. Therefore, one of the issues that would be analyzed and discussed would be the effects of the project on the aspen resource.

The Affected Environment refers to those national forest system lands that fall within the bounds of the Fourmile Project Area. This analysis boundary provides a discrete area for analysis in which a quantifiable comparison can be made between the existing condition, the no action alternative, and the action alternative. For context, this area is compared with adjacent national forest lands (all of the other districts on the Chequamegon Nicolet National Forest) under the same management area prescriptions and also with forest-wide figures for the same management areas.

## Relevant Laws, Regulations, and Policy

### Regulatory Framework

#### **Land and Resource Management Plan (Forest Plan)**

The Chequamegon-Nicolet National Forest Land and Resource Management Plan (Forest Plan) provides Forest-wide Goals, Objectives and desired future conditions as defined in various management areas. Achieving the desired future condition is guided by both forest-wide (Forest Plan pages 2-1 through 2-38) and management area specific standards and guidelines (Forest Plan pages 3-1 through 3-60). A “standard” is defined as a course of action that must be followed, or a level of attainment that must be reached, to achieve forest goals. Deviation from a standard must be analyzed and documented in a Forest Plan amendment. A “guideline” is also a course of action that must be followed. However, guidelines relate to activities where site-specific factors may require some flexibility. Deviations from a guideline must be analyzed and documented in a project level environmental assessment or environmental impact statement.

Many of the silvicultural techniques used for the management of timber species are found in the forest-wide standard and guidelines. Also found in the forest-wide standard and guidelines (S&Gs) are the desired age/size structure and rotation ages of individual forest types. Additional area specific upland forest type composition objectives, desired future conditions, standards and guidelines are found in the management area descriptions (Forest Plan chapter 3). These forest and management area standards and guidelines provide silvicultural objectives for the management of the main forest types found in the CNNF. They also provide some ecological and social parameters which need to be met to achieve overall forest goals for all resources. These silvicultural objectives and ecological/social parameters would be used in the manipulation of the vegetation to move towards the desired future condition.

### **Federal Law-*National Forest Management Act (NFMA)***

To comply with NFMA all stands were inventoried and categorized for suitability of harvesting or meeting other objectives.

### ***Management Area***

Management Areas (MAs) are used to define where different management activities and vegetative emphases are applied. Each area is defined by a primary emphasis or MA prescription that guides activities taking place within it. MAs 1-4 are based on Landscape Type Associations which is a landscape scale ecological unit. These units are relatively homogeneous with respect to terrestrial resources such as vegetative communities, soils and landform. MA 5 (Wilderness areas) and MA 6 (Semi-primitive non-motorized areas) are usually defined by geographic boundaries such as roads, rivers and private boundaries. MA 8 areas are generally delineated by forest type or political boundaries. Each of these MAs are further subdivided into smaller units with more site specific desired future conditions and guidance. This report would be limited to the desired condition and activities recommended in MA 2A, 2B, 4A, 4B, 8A and 8D found within the Fourmile project area.

MA 2A is described as Uneven-aged Northern Hardwoods. Relatively continuous mid to late-successional uneven-aged northern hardwoods and northern hardwood-hemlock forest communities dominate the area. Uneven-aged management (improvement and selection harvests) is the most common silvicultural practice although some shade intolerant species such as aspen are maintained through even-aged practices. Hardwood patch sizes reach thousands of acres in size. Edge habitat is low, temporary openings are small and long lived conifer components such as white pine and hemlock are encouraged. Resulting habitat favors species such as black-throated blue warblers, goshawks and raccoons.

MA 2B is described as Uneven-aged Northern Hardwoods. Relatively continuous mid to late-successional uneven-aged northern hardwoods and northern hardwood-hemlock forest communities dominate the area. Uneven-aged management (improvement and selection harvests) is the most common silvicultural practice although some shade intolerant species such as aspen are maintained through even-aged practices. Hardwood patch sizes reach thousands of acres in size. Edge habitat is low, temporary openings are small and long lived conifer components such as white pine and hemlock are encouraged. The main difference between MA 2A and MA 2B is extended rotation ages are to be used in MA 2B where standard rotation age is used in MA 2A.

MA 4A is described as Conifer: Red-White-Jack Pine. The area is characterized by upland conifer forests mixed with other forest communities. While natural conifer and plantations are common both hardwood and aspen are well represented in this landscape. Even-aged practices that maintain early to mid-successional communities are evident and intensive. Numerous small to medium patches up to hundreds of acres are present. Young forests, small permanent openings and mixed pine-oak are commonly

interspersed throughout the area. Moderate to high levels of edge creates habitat suitable to pine warbler, Connecticut warbler and red squirrel.

MA 4B is described as Natural Pine-Oak. The area is dominated by natural pine and oak. Large patch conditions are restored or maintained, and jack pine plantations are often converted to long lived species. Extended rotation ages are used to achieve large diameter trees. Timber harvest and fire is often used to regenerate pine and oak.

MA 8A is the Argonne Experimental Forest (AEF) is one of 80+ USDA Forest Service experimental forests and ranges (<https://www.fs.fed.us/research/efr/>). Experimental forests and ranges (EFRs) are considered living laboratories and are home to numerous experiments on vegetation, soils and watersheds. Long-term silvicultural experiments on EFRs have been influential in regional management, policy, and ecological model validation for decades. The AEF is home to foundational research in northern hardwood silviculture that is used by major landowners in the Great Lakes region and beyond. The AEF (established in 1947) is part of the Chequamegon-Nicolet National Forest and administered by the Northern Research Station of the USDA Forest Service (<https://www.nrs.fs.fed.us/ef/locations/wi/argonne/>).

MA 8D is an area within ¼ mile of Existing, Eligible and Potentially Eligible Wild, Scenic and Recreational Rivers. These areas provide habitat for riparian dependent fish and wildlife species and are important ecological corridors within the landscape. Long-lived species such as white pine, hemlock, red pine, sugar maple and yellow birch are emphasized. Uneven-aged management is the primary management activity to create large tree character and visually pleasing scenes. Even-aged management is used to develop large tree character and maintain or enhance desired species composition. Edge habitat is generally low favoring wildlife species such as bald eagle, wood duck turtles and muskrat.

There are areas within this project area that are bordering but not in Management area 8E. This management area is defined as an Existing Research Natural Area (RNA). No timber harvesting is allowed within the RNA except for if the desired vegetation type would be lost or degraded without treatment. Areas bordering this area should have guidelines of similar prospective. All stands being proposed near RNAs have been prescribed treatments for meeting those guidelines while still meeting the guidelines of their actual management area.

### **Other Guidance or Recommendations**

Wisconsin's Forestry Best Management Practices (BMPs) would be followed on all stands.

## **Topics and Issues Addressed in This Analysis**

### **Purpose and Need**

Most of the needs in the Fourmile Project Area are based on Forest Health. From the original scoping letter it was stated that we needed to contribute towards satisfying the demand for wood products and promote healthy forests. We need to promote healthy forests by maintaining or enhancing the simple structure of early successional forests (primarily aspen), maintain or enhance the large, relatively continuous, mid to late successional northern hardwood forest, maintain or enhance upland conifer forests mixes with other communities like northern hardwoods, and increase or maintain forest resiliency to insects and disease. To accomplish these needs they were reorganized and stated differently in this author's perspective below and addressed as to how to accomplish them using guidance from the Forest Plan.

## **Need 1- There is a need to improve the stocking in a variety of overstocked forest types which would increase forest resiliency to insects, disease and fire.**

Currently in the Fourmile Project Area there are a variety of vegetation types that are overstocked. All species in the Northern Wisconsin area when they reach overstocked or crowded conditions growth and vigor starts to decrease rapidly increasing the likelihood of trees being less resilient to insects and diseases.

When managing balsam fir it is highly encouraged to not only keep stocking at a reasonable level but to increase diversity into the stand to reduce the potential for spruce budworm damage (Johnston, 1986). The same goes, as one may assume, for managing spruce when trying to keep up resistance to spruce budworm and spruce decline in general.

When managing red and white pine it is highly encouraged to control the stocking because it is the most feasible way of controlling the development of a stand (Lancaster & Leak 1978). The more growing space a tree has the better. Growing space is the physical area, and resources of the site associated with it that is available to and utilized by a tree (Helms, 1998). A lot of the hardwood stands in the Fourmile project area are also overstocked. These stands will be talked about further in Need 2 where the goal is to achieve uneven- aged conditions.

To determine when stands are overstocked one should reference the Forest Plan and follow the guidelines laid out on pages 2-4 through 2-13, and on FF-1 and FF-2. In the table below is a summary of the current acres of each of the species that have reached an overstocked condition and is available to have a commercial thin implemented on it if an action alternative is selected.

**Table 1. Existing overstocked acres compared to acres in the Fourmile project area for selected species**

<b>Species</b>	<b>Total Acres</b>	<b>Overstocked acres</b>
<b>Aspen</b>	3354	966
<b>Balsam Fir</b>	657	302
<b>Eastern White Pine</b>	1038	736
<b>Northern Hardwood</b>	10405	6982
<b>Oak</b>	413	99
<b>Paper Birch</b>	472	439
<b>Red Pine</b>	3834	3398
<b>Spruce</b>	443	190

## **Need 2- There is a need to improve the stand structure in even-aged and two-aged northern hardwoods and to maintain good stand structure in uneven-aged northern hardwoods while maintaining or enhancing within stand species diversity**

In Management areas 2A, 2B, 4A, 8A, and 8D of the Fourmile Project area, there are about 6,982 acres that have been identified as overstocked, in need of improved stand structure and suitable for timber production.

The Chequamegon-Nicolet Land and Resource Management Plan (Forest Plan) recommends that managed even-aged and uneven-aged northern hardwood stand densities be maintained according to standard stocking charts and northern hardwood literature (Forest Plan, p. 2-7). The Forest Plan also emphasizes stand density management for managing vegetation for resistance to pest outbreaks (Forest Plan, p. 2-26). In addition, one of the Forest Plan goals is to contribute toward satisfying demand for wood products (see Need 5) through environmentally responsible harvest on National Forest System lands (Forest Plan, p. 1-6).

Therefore, there is a need to improve stand structure while reducing stand densities in accordance with Forest Plan direction and standard northern hardwood management literature. This would provide for healthier stands of more vigorous trees. This density management would be accomplished through commercial timber harvests using individual tree selection treatments which results in the development of a new age class within the stand.

The vast majority of the hardwood stands in the Fourmile Project Area are being managed for an uneven-aged objective. The Forest Plan gives guidance to manage uneven-aged northern hardwood stands with at least 3 distinct age classes and for specific diameter distributions (Forest Plan, pp. 2-6 through 2-8). Harvest activities should take place on a 10 to 20 year intervals (Forest Plan, pp. 3-8 and 3-10).

Currently, approximately 67% of the northern hardwood stands in the project area are in an even-aged or two-aged condition. Some have been selectively cut in the past and have two distinct age classes, but only a quarter of them have three distinct age classes (Forest Plan, p. 2-7). Individual tree selection harvests in project area stands in the near future would maintain those stands which are currently uneven-aged and move the remaining hardwood stands towards the desired future condition of uneven-aged by adding a second or third distinct age class.

By increasing the number of stands in an uneven-aged condition the project area would be more resilient to health issues such as insect and disease outbreaks. This is due to the fact of removing the suppressed and most vulnerable trees and improving growing conditions for the healthier trees within the stands. Healthy trees with favorable growing space are less vulnerable to widespread insect or disease damage.

### **Need 3- There is a need to modify the project area's age class distribution to more closely reflect Forest Plan desired future conditions.**

As you can see from table 2 below, most of the main species age class distributions of the Fourmile Project Area are terribly skewed towards the older age classes. Too much of the composition being in the older age classes can lead to a reduction of a species in that area, reduction in resiliency against insects and disease, and stagnation of a stand. Currently, there is an overabundance of older age and a shortage of youngest age classes in the project area.

The age class distribution of aspen would be modified mainly by regenerating older stands into new, young stands using the clearcut method. Also, some opportunities to convert aspen to longer lived species (especially in High Scenic Objective Areas (SIO)) could further reduce the amount of over mature aspen in the project area. These would mainly be done via a shelterwood method or commercial thinning. Depending on the stand composition either natural regeneration or planting would occur.

Paper birch would mostly be switching to the younger age classes by means of shelterwood harvests to repopulate this group.

In the jack pine group there aren't a lot of stands but if the action alternative is chosen a clearcut harvest with scarification and planting back to jack pine would get the age classes back into a more reasonable distribution.

The current spruce population is at a difficult junction at this point with spruce budworm still in the area effecting many stands along with spruce decline. Some areas would need to be modified to take out dead, dying and threatened spruce before the spruce budworm gets it. Salvaging and planting is a very

viable option if stands have been too far infested. If the stands are still healthy it would be best to thin them out to allow for healthier trees so they may live longer against these attacks.

Northern Hardwood stands as discussed in need 2 are trying to be managed in an uneven-aged fashion so age class distribution isn't such a big deal but it is in the Forest Plan to at least consider so the table is included.

**Table 2. Existing age class distribution in the Fourmile Project Area compared to Forest Plan guidance**

Aspen Age Class	Desired Condition	Existing Condition
0-10	15-25%	4%
11-20	15-25%	2%
21-45	45-55%	63%
46+	5-15%	32%

Paper Birch Age Class	Desired Condition	Existing Condition
0-20	20-30%	0%
21-40	20-30%	2%
41-60	20-30%	0%
61+	20-30%	98%

Red Pine Age Class	Desired Condition	Existing Condition
0-20	10-20%	1%
21-60	25-35%	32%
61-100	25-35%	52%
101+	20-30%	14%

Jack Pine Age Class	Desired Condition	Existing Condition
0-10	10-20%	0%
11-30	30-40%	46%
31-50	30-40%	17%
51+	15-25%	37%

White Pine Age Class	Desired Condition	Existing Condition
0-20	10-20%	0%
21-60	20-30%	12%
61-120	30-50%	68%
121+	25-35%	19%

White Spruce Age Class	Desired Condition	Existing Condition
0-20	15-25%	0%
21-60	30-50%	51%
61-80	15-25%	24%
81+	20-30%	25%

Red Oak Age Class	Desired Condition	Existing Condition
0-19	15-25%	0%
20-59	30-50%	1%
60-79	15-25%	11%
80+	20-30%	88%

Balsam Fir Age Class	Desired Condition	Existing Condition
0-10	15-25%	0%
11-30	35-45%	15%
31-45	25-35%	30%
46+	5-15%	55%

Hardwood Age Class	Desired Condition	Existing Condition
0-20	10-20%	0
21-60	30-40%	4%
61-100	30-40%	49%
101+	10-30%	14%
UEA		33%

**Need 4- There is a need to modify the project area's species composition to more closely reflect Forest Plan desired future conditions.**

As one can see from the chart below there is a need to convert some species into others to better meet Forest Plan standards. Having a diverse forest on a landscape basis is important to keep up forest health and to maintain habitat for a variety of species.

Conversion would be accomplished if the action alternative is chosen by means of shelterwoods with underplanting to encourage long lived species, overstory removals to release the existing understory, and some thinnings to remove certain species. Also some conversions would also be taking place naturally.

**Table 3. Existing species composition compared to Forest Plan guidance**

Forest type	MA 2A		MA 2B		MA 4A		MA 4B		MA 8A	MA 8D
	Existing	Desired	Existing	Desired	Existing	Desired	Existing	Desired	Existing	Existing
Aspen	12%	5-20%	8%	0-10%	27%	10-30%	18%	0-7%	8%	14%
Balsam Fir	3%	0-3%	4%	0-3%	3%	0-3%	3%	0-3%	1%	0%
Paper Birch	1%	0-5%	5%	0-2%	1%	0-5%	1%	0-5%	0%	46%
Jack Pine	8%	0-2%	0%	0-2%	1%	0-35%	2%	3-6%	4%	0%
Red & White Pine	26%	5-20%	7%	0-10%	29%	10-50%	36%	45-70%	1%	10%
Northern Hardwood	43%	40-70%	72%	50-80%	27%	0-25%	29%	0-10%	77%	29%
Oak	0%	0-5%	0%	0-3%	0%	0-25%	7%	10-25%	0%	0%
Open	5%	0-1%	1%	0-1%	5%	1-6%	2%	2-8%	3%	0%
Other species	2%	0-15%	2%	0-15%	7%	0-5%	2%	0-10%	6%	0%

Note: This table only highlights the upland types with in the project area.

#### **Need 5- There is a need to continue the experiments currently occurring on the Argonne Experimental Forest**

Research is a very important aspect within forest management. It helps managers to see that they are currently doing the right practice for each forest type or shows them an alternative of what might be better for certain stands within the ever changing environment. Forests and forest dynamics change overtime either due to environmental factors or man made changes. Experimental forests allow research to be done to allow managers to keep up with the newest, and best available science. Currently there are three experiments going on within the Argonne Experimental Forest and two studies going on on the Eagle River Florence Ranger district. All of these projects are within the Fourmile Project area and are due for another treatment to allow for the studies to continue.

#### **Need 6- There is a need to satisfy timber demand**

The Forest Plan includes Goal 2.5, which identifies the need to contribute toward satisfying demand for wood products through environmentally responsible harvest on National Forest System lands (p. 1-6). Other Forest Plan guidance (pp. 2-7; FEIS, App. F, p. 1), as well as the majority of scientific literature pertinent to northern hardwood management, emphasizes the improvement of timber quality as an inherent objective. Improvement of stand quality, through time, would be beneficial to the local economy and to the taxpayers.

Currently, there are about 13,112 acres of overstocked or mature/over mature stands in the project area. To meet Forest Plan species composition, species age class and forest health objectives there is a need to manipulate some of these stands through standard silvicultural techniques outlines in the Forest Plan (some overstocked stands would not be treated due to access issues, wildlife concerns, or sensitive species/object concerns).

Species composition objectives can be addressed through conversion thru active management favoring conditions for the desired species. Species age class objectives can be addressed by removing timber and the use of standard regeneration techniques. Forest health objectives can be achieved through reduction of stocking in overstocked stands, favoring species best suited to the site, encouraging species

diversity and regenerating vigorous species. These objectives can be achieved through active management such as individual tree selection, improvement cuts, commercial thinning, shelterwood harvest, clearcut, site preparation and planting. Natural regeneration is also used in many cases but is encouraged by the use of canopy gaps and other regeneration techniques such as shelterwood and final harvest cuts. All these techniques would be used to achieve Forest Plan objectives of species composition, age class distribution, and forest health with the result of producing wood products which would satisfy demand in an environmentally responsible fashion.

## Methodology

The information gathered to do this analysis was collected by forest service employees and contractors taking common stand exams also referred to as plots. These plots were taken in every stand within the project area boundary. This data was collected in the area in various years ranging anywhere from 2008-2017. This data was then uploaded into FSveg database where it was sorted. This database has become the central clearinghouse for stand inventory data that was formerly housed in the CDS database. It is used in conjunction with the FACTS database which stores planned and accomplished management activities within the stands. After the data was sorted, the District silviculturist exported the information into an MS Excel spreadsheet for analysis, looking at only the upland forest types to determine what was currently there and its condition.

## Information Sources

All information on current stand condition was supplied by common stand exams done within the agency to agency standards.

## Incomplete and Unavailable Information

All stands on National Forest System land within the project area were looked at on the ground to determine existing condition and whether or not treatment was necessary. Therefore all information needed was available.

## Existing Condition

On the Eagle River-Florence District there are approximately 248,835 acres of upland forest types. Within the 55,208 acre Fourmile Project Area approximately 24,264 acres are upland forest managed by the United States Forest Service. As discussed earlier, the Forest Plan has broken up the entire forest into management units. Within the Fourmile project area there are 10 different Management Areas represented. The table below shows how the District and Fourmile Project area are broken down.

**Table 4. Existing management areas on the Eagle River- Florence district and in the Fourmile project area**

Management Area	1B	1C	2A	2B	2C	4A	4B	4C	5	6A	8A	8D	8E	8F	8G
% on District	1%	1%	16%	20%	20%	5%	3%	1%	11%	0.3%	2%	6%	3%	4%	7%
% of Fourmile	0%	0%	8%	8%	0%	12%	16%	0%	0%	2%	10%	<1%	2%	8%	5%

Note: The above numbers were calculated from a forest wide spreadsheet created by John Schmidt.

The Fourmile Project only would be proposing treatments to be done in management areas 2A, 2B, 4A, 4B, 8A, and one stand that was mistakenly mapped under 8F. Those would be the only management areas (excluding management area 8F) we discuss within this report. See Table 3 from above to see the

distribution of species in each management area. The table is made up of only the upland areas since no activities would be proposed in the lowland areas.

### **Aspen (*Populus tremuloides*)**

Aspen management is a key area of interest within the Forest Plan and by a number of interest groups. Young aspen is highly valuable as habitat for a number of game and non-game species. At the same time, it is highly sought after as a source of pulpwood for high quality paper and sawtimber for a variety of other products.

Within the Fourmile Project Area, there are about 3,354 acres of aspen forest types. Aspen is a shade intolerant species and is considered a “pioneer” tree species on sites that are recovering from intense disturbance. Under natural conditions, aspen is regenerated by disturbances such as wildfires, windstorms followed by high intensity fires or other events that leave a site devoid of vegetation. These conditions are favorable for aspen root suckering and seeding (Forest Plan FEIS Appendix F, pp. F-4 and F-5).

Aspen is not a long-lived species. By age 50, decay pathogens start to become a concern and are a major deterrent to growing aspen on long rotations (Perala and Russell, 1983, pp.113-14). After 50-70 years, these stands would begin to deteriorate. The deterioration of the aspen stand begins when the crowns of older trees can no longer grow fast enough to fill voids in the canopy left by dying trees. By age 60-80 years, many aspen trees would have died and succession to more shade tolerant trees would begin (Forest Plan FEIS Appendix F, p. F-4). Deteriorating clones would produce significantly fewer root suckers following harvest or catastrophic disturbances than their healthy counterparts.

Wildfires have largely been eliminated from the Great Lakes landscape through active fire suppression. In the absence of stand replacement disturbances, aspen stands would gradually convert to types dominated by more shade tolerant species. Therefore, man-caused disturbance events are needed to maintain aspen on landscape scales.

Where regeneration of aspen types is the objective, clearcutting is the optimal method for regenerating fully-stocked stands and maximizing growth (Perala,1990, p.561). Aspen needs full sunlight for vigorous growth and successful competition with shade tolerant species. As little as 10-15 square feet of basal area of residual overstory would slow aspen sucker growth by 35-40% (Perala,1977, p.3). Thus, shelterwood and seed tree harvests are not as effective in regenerating aspen stands. Individual tree selection is not effective in regenerating aspen stands since it maintains excessive shade-producing overstory trees.

[Table 2](#) from above concisely displays a summary of the desired and current age class distribution of aspen.

As the table clearly illustrates, there is an overabundance of aspen in the oldest age class and there is a lack of representation in the youngest age class. This is the case both within the Fourmile Project area and at the forest level. It is for this reason that even-aged aspen regeneration is being proposed in accordance with Forest Plan direction (p. 2-5).

To meet the Desired Future Condition of 15-25% in the 0-10 age class for aspen, approximately 711 acres of aspen need to be regenerated. This acreage should be taken from the 21-45 and 46+ age classes. In the proposed action however we plan to regenerate more than those acres because of the overabundance of older aspen age classes. If left these stands would deteriorate and most likely convert to another species since it would be probably 8-10 years before we can come back to the Fourmile project area. Which would not meet Forest Plan guidelines for diversity. Getting the older age classes maintained is probably more of a priority then getting the younger age class in order for that reason.

To meet the objectives of High SIO areas some conversion practices would be taking place to remove the aspen and convert stands to a long lived species type. In the proposed action some shelterwood cuts with supplemental plantings are prescribed to help convert to either red oak, white spruce, or white pine. Another method that would be used are thinnings to convert to those species as well. In high SIO areas the Forest Plan dictates that there should be minimal evidence of forest management activities.

## **Balsam Fir (*Abies balsamea*)**

At about 657 acres in the uplands, balsam fir comprises a little over 2% of the Fourmile project area.

Balsam fir (*Abies balsamea*) has a strong ability to become established and grow under the shade of larger trees. It is classified as very tolerant. Typically, balsam fir grows in mixed stands with paper birch, aspen, maple, and other species. Balsam fir stands break up at fairly young ages and tend not to persist into old ages. In the absence of disturbance, the sites tend to become occupied by longer lived and more shade tolerant species such as red and sugar maple. Rotation ages are generally between 45 and 60 years of age depending on the site and the risk factors (Forest Plan FEIS Appendix F, p. F-8).

Balsam fir can be managed under both even and uneven-aged silvicultural systems. Even-aged systems are the preferred method. [Table 2](#) displays the desired age class distribution (Forest Plan, p. 2-11) and what is currently existing in the project area.

Currently, there is a great overabundance of balsam fir in the 46+ year age class and a lack in the 0-30 year age classes. This presents an opportunity to regenerate some older stands to move conditions more in line with desired conditions. Opportunities to do this may be limited since many of these stands tend to be small, isolated, or in areas with conflicting management objectives.

## **Paper Birch (*Betula papyrifera*)**

Occupying only 472 acres, paper birch is not an abundant species within the Fourmile Project Area. Nonetheless, the Forest Plan gives direction (p. 2-6) to manage the Forest's paper birch resource with 25% in each of the age classes as shown in [Table 2](#).

Paper birch (*Betula papyrifera*) is a sun-loving species that regenerates areas after widespread disturbances, such as stand-replacement fires. It is a short-lived species that must be regenerated using even-aged methods (Forest Plan FEIS Appendix F, pp. F-8 and F-9; Perala and Alm, 1989). It also regenerates best when mechanical site prep, such as the use of a salmon blade, follows the harvest. If not regenerated by some sort of disturbance, the paper birch type would be replaced by more tolerant types, such as oak or northern hardwoods.

Within the project area, 98% of the paper birch is presently between 66 and 102 years of age. This is beyond the standard rotation age and is approaching the extended rotation age given in the Forest Plan (p. 2-4). If this birch is not regenerated during the next 20 years, it would most likely convert to other more tolerant types through natural succession.

## **Red Pine (*Pinus resinosa*)**

Red Pine (*Pinus resinosa*) occupies about 3834 acres of the Fourmile project area.

Red pine is fairly intolerant of shade, but more tolerant than species such as aspen, paper birch, and jack pine. It is best managed under even-aged conditions (Forest Plan FEIS Appendix F, page F-6). Desired age classes for red pine are given in the Forest Plan (p. 2-10) and are displayed in [Table 2](#), above.

The bulk of the red pine in the Fourmile Project Area was planted in the era of the Civilian Conservation Corps. Planting records from the 1930's and early 1940's describe the planting of vast areas of cutover lands in the project area. These 60-70 year-old stands comprise a "spike" in the amount of 61-100 year old stands. On the other hand, there are only 50 acres of red pine in the 0-20 years of age.

This project area leads to a great opportunity to maintain these historical stands, and to sustain the investment that was original put into these areas. In the proposed action, 2549 acres would be managed either by a thinning to reduce stocking and to increase growth and vigor, or complete the transition of the stand to another species by means of shelterwoods and clearcuts. Another treatment known in the proposed action as a restoration or restoration thin were prescribed in some of these areas. This treatment would be encouraging these types of stands to revert back to a more natural state then they are now (since these areas were heavily site prepared and planting back in the 1930's).

## **Northern Hardwoods**

Within the Fourmile Project Area are approximately 10,405 acres of Northern Hardwood types.

Northern Hardwoods are forest types that are dominated by sugar maple (*Acer sacharum*). Northern hardwood stands can be highly variable and typically contain a wide variety of species, including white ash, red maple, basswood, yellow birch, black cherry, and hemlock. Other associates may also be present, such as aspen, oak, paper birch, American elm, and pine species.

Because many of the constituent northern hardwood species are more shade tolerant, northern hardwood stands can be managed under a wide variety of silvicultural systems. Most commonly, they are managed under the uneven-aged single tree selection method or the even-aged shelterwood method.

Management Areas 2A, and 2B does not emphasize even-aged management, but, rather, uneven-aged management (Forest Plan, p. 3-8 thru p. 3-9 and p. 3-44 thru p. 3-46). One of the goals of this project is to maintain and enhance the within-stand diversity of the northern hardwood stands. Certain design features would be used in the selectively harvested areas to foster species diversity. To name a few, these would include the use of large canopy gaps, and whole tree logging.

As [Table 2](#) show, many of the hardwood stands in the Fourmile Project Area are in the 61-100 year age class. In fact 49% of the hardwood falls within this 40 year range.

As previously noted, for the majority of the analysis area, the Forest Plan emphasis is on uneven-aged management. Only 33% of the hardwood stands in the project area are currently *uneven-aged*- that is, containing three or more distinct age classes. Thus, one of the needs identified for this project is to move more of the hardwood stands toward uneven-aged conditions.

### White Spruce (*Picea glauca*)

There are about 443 acres of white spruce and upland black spruce within the Fourmile Project Area. This is just over 1% of the upland forested land.

White spruce is intermediately shade tolerant. It is more tolerant than aspen and paper birch, but less tolerant than sugar maple, balsam fir, or hemlock. White spruce is capable of reproducing in the understories of some early successional stands, but stocking rates are variable and usually not high.

White spruce is best managed under even-aged silvicultural systems using methods such as shelterwood or seed tree for regeneration. Artificial regeneration (planting or seeding) is also an effective and commonly used method (Forest Plan FEIS Appendix F, p. F-7).

Currently, on the Chequamegon-Nicolet, there is a disease complex known as "Spruce Decline" that is causing the rapid, widespread decline and mortality of white spruce stands. In 2004, the Forest completed an Environmental Assessment for the salvage of approximately 5,100 acres. In addition, several thousand more acres of spruce stands are currently being monitored to determine whether they should be salvaged. Stands within the Fourmile Project Area have been reviewed in various years and most were found to be healthy at the time of exam but since then they have not been looked at to determine if the decline has reached them. If these stands are determined to be indeed in decline with the proposed action they would be salvaged, burned then planted back to white spruce to retain the amount of spruce we have in the district. If they are not declining they would be thinned to help them stave off the potential for decline by trying increase growth and vigor.

**Table 5. Existing White Spruce age class distribution compared to Forest Plan guidance**

White Spruce Age Class	Desired Condition	Existing Condition
<b>0-20</b>	15-25%	0%
<b>21-60</b>	30-50%	51%
<b>61-80</b>	15-25%	24%
<b>81+</b>	20-30%	25%

## **Northern hardwood structure**

[Table 2](#) displays the current structure categories within the project area. The Forest Plan calls for uneven-aged structure for mixed northern hardwood on a good chunk of the forest (Forest Plan p. 2-8 through 2-9) but more intensely within Management Areas 2A, and 2B (Forest Plan p 3-7 through 3-9). The even-aged and two-storied stands definitely do not meet Forest Plan desired structure conditions. The desired condition of these hardwood stands is to develop uneven-aged structure which can be done with improvement or selection harvests.

## **Stocking Density**

The Forest Plan specifies desired stocking levels for red pine (Forest Plan p. 2-10), white pine (Forest Plan p.2-12), and white spruce (Forest Plan p. 2-13). Balsam fir doesn't have a stocking level of its own in the Forest Plan but it is usually a balsam fir-aspen stand and its stocking can be found on page 2-5 of the Forest Plan.

The areas mentioned as overstocked in the needs section of this document are areas that have stocking levels well beyond the Forest Plan guidelines and could be thinned to reduce the densities to more desired levels (as outlined in the Forest Plan) using commercial timber harvests. These harvests would improve stand quality and vigor and provide forest products to the economy.

## **Aspen Age Class Distribution**

The existing and desired distribution from the Forest Plan was displayed previously in [table 2](#). This table displays a shortage of young aspen in 0-10 year age class and a surplus in 46+ age class. In order to improve the representation of aspen in the various age classes and get closer to the recommended distribution in the Forest Plan, areas appropriate for aspen management that contain aspen in the older/over mature age classes should be clearcut and regenerated to young aspen.

## **Required Monitoring on any active management**

The marking by contract crew or Forest Service employees would need to be monitored whether it is done by the forest check cruiser and/or the silviculturist to make sure the intent of the prescriptions are implemented on the ground. The timber sale administrator would monitor or inspect the sale operations to make sure the contact provisions are being followed. All planting areas would need to be surveyed (survival surveys) to monitor success of the establishment of the planted seedlings. All naturally regenerated areas would need to be monitored using stocking surveys to check on the success of natural regeneration which would include areas that have been scarified, aspen clearcuts and hardwood selection harvests. Checklists should be used to make sure design features from this document have been used during sale layout and preparation.

# **Environmental Consequences**

## **Alternative 1 – No Action**

Alternative 1 is a no action alternative. We would not be implementing any new activities in this area.

## **Alternative 2 – Proposed Action**

In the proposed action we would be proposing various activities within the project area on a variety of species. Below in [table 6](#) is the proposed treatments within the Fourmile project area. The current conditions, desired conditions and the objectives that were developed due to the differences between the two were discussed in earlier sections of this document. Those differences originally created a need for change which became the purpose and need of the resulting NEPA document. The treatments below address those objectives.

Table 6. Proposed harvesting actions in alternative 2

	Aspen	Balsam Fir	White Pine	Hardwood/Hemlock	Jack Pine	Red Oak	Paper Birch	Red Pine	White Spruce	Total
<b>Removal</b>	45	166	16	5	0	0	0	0	0	232
<b>Clearcut/Coppice</b>	1053	73	0	37	13	0	0	8	6	1190
<b>Improvement</b>	0	0	0	263	0	0	0	0	0	263
<b>Selection</b>	0	0	0	5130	0	39	0	0	0	5249
<b>Shelterwood</b>	0	0	42	0	17	84	253	6	0	403
<b>Thin</b>	186	11	407	43	11	98	139	2325	193*	3331
<b>Restoration</b>	25	0	0	0	4	4	0	147	0	181
<b>Salvage/Sanitation</b>	27	0	13	0	33	114	0	0	40	227
<b>Pre-Commercial Thin</b>	0	0	29	0	0	0	0	63	0	92
<b>Experiments</b>	0	0	0	526	0	0	0	0	0	526
<b>Total</b>	1336	250	507	5979	78	339	392	2549	239	11669

Note: the asterisk under the white spruce thin indicates that depending on current condition these stands would either be salvaged or thinned

After most of these cuts have occurred some forest types may change or there may be potential need for planting to happen whether that be supplemental plantings to get more long lived species into an area or a full plant to return a species to its rightful site. Below is a chart of just the conversions that occurred by management area this would have either been from those plantings or from the cut itself.

Table 7 Conversion to Forest types due to harvests or plantings

Forest Type	MA 2A	MA 2B	MA 4A	MA 8A	MA 8D
<b>Aspen</b>	-4.52 acres	-9.54 acres	-98 acres	0 acres	0 acres
<b>Fir</b>	0 acres	0 acres	-3.32 acres	0 acres	0 acres
<b>Hardwood</b>	0 acres	117.56 acres	18.47 acres	0 acres	0 acres
<b>Jack Pine</b>	0 acres	0 acres	0 acres	0 acres	0 acres
<b>Oak</b>	4.81 acres	0 acres	0 acres	0 acres	0 acres
<b>Birch</b>	0 acres	-117.36 acres	-18.47 acres	0 acres	0 acres

<b>Red &amp; White Pine</b>	0 acres	9.19 acres	106.88 acres	0 acres	0 acres
<b>Spruce</b>	0 acres	0 acres	-5.57 acres	0 acres	0 acres
<b>Total change</b>	9.33 acres	253.65 acres	239.57 acres	0 acres	0 acres

If a unit received a clearcut or has gotten a salvage cut that forest type would be replanted or natural regeneration to that same species would occur.

**Table 8. Proposed reforestation activities and other maintenance to stands planned in Alternative 2**

<b>Activity</b>	<b>Acres Planned</b>
Aspen Site Preparation	966
Biochar Application	240
Burn	334
Manual Site Preparation (Canopy gaps)	5249
Full Plant or Underplanting	647
Mechanical Scarification (for natural Regeneration)	249
Mechanical Scarification (for artificial Regeneration)*	103

The above acres are estimated based on ArcGIS stand layers these may change slightly when being implemented on the ground due to adjusting GIS stand lines compared to what is truly on the ground. Another example of reduction of acres that would occur, is we based these acres on full stands, if an activity is next to a river/stream Wisconsin Best Management Practices would be used to make sure the river/stream is protected so there is potential no treatment zones or a change of prescription zone to only due uneven-aged treatments in that thin strip next to river/stream.

Most harvests in this project in northern hardwood stands would receive individual tree selection treatments (either a true selection cut or improvement cut). Stands of hardwood forests that are still essentially even-aged or have poor uneven-aged structure receive prescriptions that call for canopy gaps to regenerate a new age class of hardwood trees to develop future structure. As part of the prescription for this harvest treatment, all of these stands would be considered for follow-up canopy gap maintenance. If a stand has well developed uneven-aged structure, gaps and gap maintenance may not be needed. Discussion of canopy gaps can be found in the Forest Plan page 2-7.

A similar situation exists with the clearcuts in that nearly all of these harvests would need follow up treatment by cutting sub-merchantable stems in aspen stands or mechanical site prep for making the site ready for planting. The cutting of sub-merchantable stems is referred to as site preparation for natural

regeneration and is done to encourage sprouting of aspen suckers to regenerate the stands with young aspen. Leaving this residual material could hamper some sprouting. Mechanical site preparation as stated above is the disturbance of the soil to make planting easier. It eliminated the unwanted competition and prepares the soil so the seedlings would have a better chance at survival.

The other reforestation activities listed are in conjunction with other harvests. The underplanting activity would follow a shelterwood harvest to establish another species such as white pine or red oak. Other mechanical site scarification known as salmon blading is scheduled to follow paper birch shelterwood harvests to create a seedbed for natural regeneration of paper birch.

Several long-term silviculture studies at AEF are due for treatment: Farm Woodlot established in 1949, Cutting Methods study established in 1951, and Managed Silviculture Study established in 2008. All of these studies contain second-growth northern hardwood forests. They are some of the few northern long-term silviculture experiments for northern hardwood forest type, which extends from Minnesota to Maine and southeastern Canada. Long-term experiments provide *in situ* data trends that short-term studies and computer models cannot provide. Re-treating these studies maintains study objectives, provides modern data to long-term records, and elevates their demonstration and education value.

The Farm Woodlot (40 ac.) was originally used to demonstrate how local farmers with 40-ac woodlots could sustainably harvest (i.e. improvement cutting) a few acres per year. In 1963, the site's demonstration objective changed to single-tree selection (Arbogast 1957), where partial harvests aimed used in sustain high quality sawtimber over decades. These partial harvests have occurred 6 times since 1949. The last harvest occurred in 1997 and another single-tree selection harvest is proposed. Re-treating the site with the same treatments maintains its value as one of the few demonstrations of single-tree selection treatments over 7 decades.

The Cutting Methods Study (120 ac.) was established in 1951 to evaluate even- and uneven-aged management in second-growth northern hardwoods (Erdmann and Oberg 1973, Niese *et al.* 1995, Strong *et al.* 1995, Kern *et al.* 2006). The study has an interpretive trail explaining forest ecology and management. Approximately 40 acres have been treated with uneven-aged methods 7 times and 80 acres were treated with even-aged methods once in the 1950s. To our knowledge, this is one of the longest-running replicated, second-growth northern hardwood silviculture studies. Re-treating the same treatments on this study would maintain its rare long-term dataset of contrasting approaches to northern hardwood management.

The Managed Silviculture Study (380 ac.) was established in 2008 to begin long-term research that combines single-tree selection and wildlife habitat management (e.g., snag creation, varying canopy gap size, etc.). The study was designed in partnership with the Wisconsin Department of Natural Resources (DNR) and has additional replications on DNR lands. The stands were entered once using single-tree selection, canopy gap creation, and thinning in 2008. Proposed treatments would include 1- to 3-acre shelterwood removals (openings) (120 ac) and thinnings (240 ac). Re-treating the study would continue the goal to maintain the study for 100 years.

A fourth study— called the Divide Canopy Gap Study (estab. 1994) - is off the AEF, but part of the Chequamegon-Nicolet National Forest and administered by the Northern Research Station. This study was established off the AEF to study forest conditions that were not available at AEF; the study site is more diverse in tree species than AEF, which is dominated by sugar maple. The study aims to understand how the growth and diversity of tree regeneration and ground-layer vegetation respond to varying canopy gap sizes that could be used in uneven-aged management. The second-growth northern hardwood stand was entered once in 1994-95 and, through timber harvesting, canopy gaps were created from single-tree openings to ½-acre openings. The proposed treatment is to maintain the openings and thin between the gaps. In addition, initial results show, in some gap sizes, poor tree regeneration (Kern *et al.* 2012, Kern *et al.* 2013) such that new ground treatments are proposed to facilitate tree establishment. The site preparations for tree regeneration include combinations of scarification, and

biochar (raked in soil) to reduce competition from vegetation and disturbance from exotic worms. The site prep treatments would be applied to small experimental areas within the 72 gaps on site. Re-treating the study would maintain the long-term study objectives to grow the regenerating trees to the canopy (over the next 5-6 decades). This study is one of few in this forest type examining long-term tree and plant responses to harvest-created openings.

Back in the early 1930s and 1940s many red pine plantations across Wisconsin were created by the



Civilian Conservation Corp. These plantations were necessary to allow stands to have regeneration after the Great Cutover. However this accompanied by fire suppression the landscape was altered from its historical condition. Most of the area was accustomed to multiple stand replacing fires within a trees lifetime. Without this common occurrence of fire the soils, species composition, and understory vegetation has drastically changed. Many stands now have thick layers of hazelnut in the understory instead of naturally regenerating tree species, and blueberry. If this alternative is chosen an intensive harvest would occur in some stands within management area 4B (which encourages use of fire for restoration purposes) to reduce the artificially planted trees in that area and multiple burns would be implemented to try to encourage that area to return to its historical condition.

**Figure 1 Uncut Land from the Oneida Purchase unit (the area we intend to do the Restoration cuts to) in 1920.**

Some clearcuts proposed in alternative 2 are greater than 40 acres in size which is against the guidelines of the Forest Plan.

Currently it is in process that we

get permission to break this rule on a few stands to treat all the overmature aspen in those stands that are meant to be treated. This use of treatment would retain the aspen populations where they are meant to be in the Forest Plan (lower amounts of older dying aspen, more of the younger aspen that is good for so many wildlife species). However if this process gets denied, to meet Forest Plan standards mini-shelterwoods ( about 10 acres in size) would be placed in between 40 acre sections to break up the continuous blocks of opening. Within these shelterwoods white pine would be underplanted to incorporate species diversity.

If the clearcutting (Coppice harvest) is over 40 acres is allowed tables 9 and 10 would still be accurate to describe the forest type distribution and age class distribution. If the shelterwood option is chosen only the aspen age class, white pine age class, and some species composition conversions would happen within management areas 2A, 4A, and 4B. 351 acres of these clearcuts are proposed (124 acres in 2A, 49 acres in 4A, and 178 acres in 4B). If you add in the shelterwoods about 60 of the 351 acres would be converted into white pine areas (20 acres in 2A, 10 acres or less in 4A, and 30 acres in 4B). Below is how the species composition in those two management areas would look if we implemented the shelterwood option.

**Table 9 Aspen Clearcuts with White Pine shelterwoods effects on species composition**

Forest type	MA 2A		MA 4A		MA 4B	
	Post Cut	Desired	Post Cut	Desired	Post Cut	Desired
<b>Aspen</b>	11%	5-20%	25%	10-30%	16%	0-7%
<b>Balsam Fir</b>	3%	0-3%	3%	0-3%	3%	0-3%
<b>Paper Birch</b>	1%	0-5%	1%	0-5%	1%	0-5%
<b>Jack Pine</b>	8%	0-2%	1%	0-35%	2%	3-6%
<b>Red/ White Pine</b>	26%	5-20%	31%	10-50%	38%	45-70%
<b>Northern Hardwood</b>	43%	40-70%	31%	0-25%	30%	0-10%
<b>Oak</b>	0%	0-5%	0%	0-25%	7%	10-25%
<b>Other</b>	2%	0-15%	4%	0-5%	1%	0-10%

The age class distribution for these two species would look like table 10.

**Table 10 Aspen clearcuts with White Pine Shelterwood effects on age class distribution**

Aspen			White Pine		
MA/ Age group	Desired	After treatment	MA/ Age Group	Desired	After Treatment
<b>0-10</b>	15-25%	40%	<b>0-20</b>	10-20%	8%
<b>11-30</b>	15-25%	2%	<b>21-60</b>	20-30%	14%
<b>31-45</b>	45-55%	47%	<b>61-120</b>	30-50%	63%
<b>46+</b>	5-15%	11%	<b>120+</b>	25-35%	15%

A traditional shelterwood usually contains 3 cuts. The first cut is a preparatory cut to enhance conditions for seed production. The second cut is an establishment cut which is used to prepare the seed bed and create a new age class. The third cut is the removal cut which is used to release the established regeneration. Some shelterwoods are proposed in High SIO areas. These shelterwoods would not be the traditional shelterwood in the fact that we would only be doing one cut to release some of the regeneration and to spark more regeneration (usually the second cut of a traditional shelterwood), the remaining trees from the original stand would not be cut. In addition to this cut, in most of the stands an additional planting is also planned to incorporate more long lived species diversity and enhance the regeneration on that site.

Many Red Pine Plantations within this project area were planted by the Civilian Conservation Corp (CCC). This effort was to help reforest the landscape after the great cut over. Many of these plantations were not placed in areas typically known for red pine, however since red pine was easy to plant, cheap, and readily available, this was the primary species planted. When red pine is planted on sites that it normally doesn't grow, it tends not to do as well (less growth, less resistant/resilient to insect and disease issues, and reaches its culmination age sooner) in the long run as it would have on an adequate red pine site. Due to

this issue some red pine plantations will need to receive their final harvest with in the Fourmile project area. The Forest Plan shows on page 2-4 that the minimum rotation age for red pine is 50. The United States Forest Service usually harvests red pine stands at the standard rotation age (100) or the extended rotation age (175) however do to the planting of red pine on off sites there may be a need to harvest slightly before this standard rotation age but still older than the minimum rotation age. The silviculturist will make this determination (whether to thin the stand or recommend for final harvest) based on site visit to the stand. If the silviculturist feels that it is in the best interest of the stand to receive the final harvest, they will recommend to the rest of the specialists a change of prescription. If any specialist has a concern with changing the prescription to a final harvest in the stand proposed, actions will then revert back to a thinning which was originally proposed. After cleared by all specialist the deciding official (district ranger) will make the final decision to move forward with the final harvest or revert back to the originally proposed thinning. This change in prescription may occur on as many as 1,327 acres of red pine stands within the project area. This number was determined based on the number of red pine stands, over the age of 80, within the Fourmile project area that Alternative 2 proposes receive a thinning treatment.

Table 11 Red Pine Age Class Distribution within the Fourmile Project Area based on various scenarios

Red Pine Age Class Distribution within the Fourmile Project Area				
Red Pine Age Class	Desired Condition	Existing Condition	After Alternative 2 Implemented Condition	If all Red Pine stands over 80 (that were in the original proposed action) received a final harvest**
0-20	10-20%	1%	6%	40%
21-60	25-35%	32%	31%	31%
61-100	25-35%	52%	50%	16%
101+	20-30%	14%	13%	13%

\*\* This is the worst case scenario. These numbers are based on what would occur if every single red pine stand over age 80, under the proposed action would receive a final harvest. This scenario is extremely unlikely, (all stands need the final harvest) so these numbers will be a less dramatic change than what is shown. The author just wanted to show the reader the worst possible outcome.

If the proposed action is chosen the following table depicts how the age class distributions would shift among the varying forest types.

**Table 12. After treatment age class distribution in Fourmile project area**

Aspen Age Class	Desired Condition	Existing Condition	After Treatment
0-10	15-25%	4%	39%
11-20	15-25%	2%	2%
21-45	45-55%	63%	46%
46+	5-15%	32%	13%

Paper Birch Age Class	Desired Condition	Existing Condition	After Treatment
0-20	20-30%	0%	75%
21-40	20-30%	2%	3%
41-60	20-30%	0%	0%
61+	20-30%	98%	22%

Red Pine Age Class	Desired Condition	Existing Condition	After Treatment
0-20	10-20%	1%	6%
21-60	25-35%	32%	31%
61-100	25-35%	52%	50%
101+	20-30%	14%	13%

Jack Pine Age Class	Desired Condition	Existing Condition	After Treatment
0-10	10-20%	0%	3%
11-30	30-40%	46%	50%
31-50	30-40%	17%	18%
51+	15-25%	37%	30%

White Pine Age Class	Desired Condition	Existing Condition	After Treatment
0-20	10-20%	0%	4%
21-60	20-30%	12%	15%
61-120	30-50%	68%	66%
121+	25-35%	19%	16%

White Spruce Age Class	Desired Condition	Existing Condition	After Treatment
0-20	15-25%	0%	9%
21-60	30-50%	51%	47%
61-80	15-25%	24%	20%
81+	20-30%	25%	25%

Red Oak Age Class	Desired Condition	Existing Condition	After Treatment
0-19	15-25%	0%	24%
20-59	30-50%	1%	1%
60-79	15-25%	11%	10%
80+	20-30%	88%	65%

Balsam Fir Age Class	Desired Condition	Existing Condition	After Treatment
0-10	15-25%	0%	36%
11-30	35-45%	15%	15%
31-45	25-35%	30%	24%
46+	5-15%	55%	25%

Hardwood Age Class	Desired Condition	Existing Condition	After Treatment
0-20	10-20%	0	<1%
21-60	30-40%	4%	3%
61-100	30-40%	49%	40%
101+	10-30%	14%	13%
UEA		33%	44%

As you can see a lot of the forest types age classes have shifted down into the lower age classes with this alternative. Having these shifts are very good for the forest as a whole since it is leading to a chunk of the stands not being stagnant, being overmature and susceptible to larger insect and disease issues. However as you also can see not all stands were taken back to the younger age classes a lot of the population is still in the older age classes. Having diversity on the landscape is not only good for visuals but also helps the effects of insects and disease.

Some percentages have shifted a bit due to changes in forest type. When a forest type switches to another type it is left with less acres than the originally planned, shifting some of the original numbers. An example of this is in the White Pine age class it looks like we reduced the white pine older age classes by a lot when in fact we didn't reduce that number at all we just changed a lot of forest types to planting white pine swaying the 0-20 age group to be a lot more than the originally would have been there.

Along with modifying some of the age classes some of these treatments would modify the species composition. Below is a table that shows the condition after the proposed action treatments are completed.

**Table 13 Post Treatment Condition after Alternative 2 is implemented**

Forest type	MA 2A		MA 2B		MA 4A		MA 4B		MA 8A	MA 8D
	Post Cut	Desired	Post Cut	Desired	Post Cut	Desired	Post Cut	Desired	Post Cut	Post Cut
Aspen	12%	5-20%	8%	0-10%	25%	10-30%	17%	0-7%	8%	14%
Balsam Fir	3%	0-3%	4%	0-3%	3%	0-3%	3%	0-3%	1%	0%
Paper Birch	1%	0-5%	3%	0-2%	1%	0-5%	1%	0-5%	0%	46%
Jack Pine	8%	0-2%	0%	0-2%	1%	0-35%	2%	3-6%	4%	0%
Red & White Pine	26%	5-20%	7%	0-10%	31%	10-50%	38%	45-70%	1%	10%
Northern Hardwood	43%	40-70%	75%	50-80%	31%	0-25%	30%	0-10%	81%	29%
Oak	0%	0-5%	0%	0-3%	0%	0-25%	7%	10-25%	0%	0%
Open	5%	0-1%	1%	0-1%	5%	1-6%	2%	2-8%	3%	0%
Other species	2%	0-15%	2%	0-15%	4%	0-5%	1%	0-10%	2%	0%

## Project Design Features and Mitigation Measures

See Appendices for all pertinent Design Features.

## Environmental Consequences

The consequences (direct effects) of implementing alternatives 1-3 would be discussed in this section as they relate to the objectives. The following table compares the alternatives side by side showing the differences in the effects on forest vegetation related to the objectives.

**Table 14. Comparison of the effects of alternatives on objective measurements**

Project Objective	Indicator	Alternative 1	Alternative 2
<b>1. Improve the stocking in a variety of overstocked forest types which would increase forest resiliency to insects, disease and fire.</b>	Acres of Hardwood Stocking modified	0 acres	6004 acres
	Acres of thinned conifer	0 acres	3496 acres
	Acres of thinned Paper Birch	0 acres	139 acres

<b>2. Improve the stand structure in even-aged and two-aged northern hardwoods and to maintain good stand structure in uneven-aged northern hardwoods while maintaining or enhancing within stand species diversity</b>	Acres of Selection/ Improvement cuts	0 acres	5433 acres
	Acres with canopy gap creation within the stand	0 acres	5169 acres
<b>3. Modify the project area's age class distribution to more closely reflect Forest Plan desired future conditions</b>	Acres treated to change age class- Aspen	0 acres	1151 acres
	Acres treated to change age class- Oak	0 acres	242 acres
	Acres treated to change age class of Paper Birch	0 acres	253 acres
	Acres treated to change age class of Conifer	0 acres	645 acres
<b>4. Modify the project area's species composition to more closely reflect Forest Plan desired future conditions</b>	% Change of Aspen type	0%	4% decrease
	% change in Balsam Fir Type	0%	1% decrease
	% change in Paper Birch type	0%	29% decrease
	% change in Jack Pine type	0%	1% decrease
	% change in Red/White Pine types	0%	4% increase
	% change in Hardwood type	0%	4% increase
	% change in Oak type	0%	5% increase
	% change in Spruce type	0%	1% decrease
<b>5. Continuation of current studies</b>	# of studies allowed to continue	0	4 studies (526 acres with AEF, 267 acres on the ERFL)

<b>6. Satisfy timber demand</b>	Volume offered for sale	0 MMBF	45.42 MMBF
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## Cumulative Effects

### Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

The following tables are included for information purposes to show the harvest history of the project area. The table below displays the history of harvests within the project area (since 1977) by the year it was completed.

Several conclusions can be drawn from examining this table: very little harvesting has occurred in the last 17 years (since about 1999), most of the clearcutting occurred in the 80's and early 90's, and a good chunk of the harvesting (65%) that occurred have been thinnings or selection type harvest. This is what led us to our current existing condition, these records therefore were only taken into consideration to determine history of the area and was not taken into consideration as part of a cumulative effect.

**Table 15. Fourmile Project Area Harvest History**

<u>Year</u>	<u>Thinning</u>	<u>Improvement</u>	<u>Removal</u>	<u>Clearcut</u>	<u>Salvage/ Sanitation</u>	<u>Shelterwood</u>	<u>Selection</u>	<u>Total By Year</u>
1975 - 1980	1087	20	0	1344	31	0	1023	3505
1981	213	0	26	258	0	58	164	719
1982	76	38	41	429	0	8	116	708
1983	140	0	8	250	0	12	53	463
1984	0	65	0	115	0	55	0	235
1985	309	0	0	75	0	38	266	688
1986	230	0	0	93	0	113	250	686
1987	198	79	0	97	0	43	99	516
1988	163	372	52	63	0	46	232	928
1989	304	204	0	172	0	131	188	999
1990	503	23	54	87	0	16	251	934
1991	114	0	30	121	0	35	18	318
1992	308	58	13	163	0	35	55	631
1993	295	51	6	68	0	115	0	535
1994	193	55	29	76	85	2	82	522
1995	14	316	73	0	0	124	0	527
1996	141	0	33	36	0	54	0	264
1997	20	15	26	7	49	156	40	313
1998	9	97	30	0	86	0	0	222
1999	68	170	16	0	210	15	0	479
2000	125	156	0	47	36	0	0	364
2001	43	50	7	0	106	11	0	217

2002	306	290	0	24	0	8	39	667
2003	353	50	0	0	0	0	0	403
2004	224	182	0	0	1	4	41	452
2005	94	47	0	0	0	11	0	152
2006	107	0	0	0	0	0	0	107
2007	0	0	0	0	0	0	133	133
2008	0	0	0	0	0	0	236	236
2010	220	0	0	0	0	0	0	220
2011	0	0	0	0	0	0	30	30
2012	14	0	0	0	0	0	0	14
2014	87	0	0	0	0	0	0	87
2015	0	0	0	75	0	9	0	84
2016	68	0	0	0	0	0	0	68
2017	58	0	0	0	0	0	0	58
<b>Total</b>	<b>6322</b>	<b>2983</b>	<b>449</b>	<b>3645</b>	<b>608</b>	<b>1396</b>	<b>3323</b>	<b>18726</b>

## Harvests in the Past, Present and Foreseeable Future for the Eagle River Florence District

The following tables (Table 16 and Table 17) is a list of activities on the Eagle River-Florence District that have happened in the recent past (last 5 years) , currently going on, or would happen in the near future. This is provided for informational purposes for analysis only when appropriate. Northwest Howell, Fishel, and Phelps project areas are all north of Fourmile Project Area. Grandma Lake Salvage, Grubhoe, and Morgan Lake are all east of the Fourmile project area. The other projects are scattered around the district. Most of the scattered district projects are mostly salvages or thinnings. The highlighted sections are the NEPAs going on within the Fourmile area.

**Table 16. Recent past and present harvesting activities on the Eagle River- Florence District**

<b>Recent Past and Present Harvesting Activities on the Eagle River- Florence District in the Fourmile Project Area</b>	
<b>Project Name</b>	<b>Harvest Acres</b>
<b>ESHI</b>	<b>237</b>
Fishel EIS	1,531
Grandma Lake Salvage CE	106
Grubhoe EIS	2,305
Northwest Howell EIS	4,507
Phelps EIS	3,723
Polecat Pine EA	879
<b>Total</b>	<b>13,288</b>

Table 17 shows the activities in the district that would be happening in the very near future (within 3 years). All of these activities (past, present, and foreseeable future) were taken into account when looking at the creating the proposed action.

**Table 17. Reasonably foreseeable future harvest activities planned on the Eagle River- Florence District**

<b>Reasonably Foreseeable Future Harvesting Activities on the Eagle River- Florence District</b>	
<b>Project Name</b>	<b>Harvest Acres</b>
Fishel EIS	1,164
Grubhoe EIS	698
Morgan Lake EA	4,359
Phelps EIS	4,212
<b>Total</b>	<b>10,433</b>

When looking at cumulative effects, actions of other districts on the forest must be considered when dealing with forest type. This is due to the Forest Plan dictating what percentages each forest type should be within each management area based on forest not on district level. To accomplish this task only forest types that had changes in each management area were looked at. If within a management area a forest type was not changed then there is no potential for cumulative effects.

If the action alternative is chosen changes to the forest type distribution would be changed as shown earlier in tables (7,8, 9,10,11, [12](#), [13](#), [14](#), and 18). Below is a table that shows based on management area where these forest type changes have occurred and by how much on a percentage bases. Only the effected Forest types are shown in the table every other type that is not shown had no change on a percentage basis within the Fourmile Project Area and was therefore not considered into cumulative effects.

**Table 18 Change in Forest Type if any Action Alternatives are chosen**

<b>Forest type</b>	<b>MA2A</b>	<b>MA 2B</b>	<b>MA 4A</b>	<b>MA 4B</b>	<b>MA 8A</b>	<b>MA 8D</b>
<b>Aspen</b>	0%	0%	-2%	-1%	0%	0%
<b>Balsam Fir</b>	0%	0%	0%	0%	0%	0%
<b>Paper Birch</b>	0%	-2%	0%	0%	0%	0%
<b>Red/ White Pine</b>	0%	0%	3%	2%	0%	0%
<b>Northern Hardwood</b>	0%	3%	4%	-1%	4%	0%
<b>Oak</b>	0%	0%	0%	0%	0%	0%
<b>Other</b>	0%	0%	-3%	-1%	-4%	0%
<b>Jack Pine</b>	0%	0%	1%	-1%	0%	0%

Due to these changes, and since species composition is usually measured at a forest wide level it was looked into what would happen forest wide to the forest type composition when having these effects occur along with all the rest of the harvests across the forest occur as well. The short term and long term effects are shown in table 19.

**Table 19 Short and Long Term effects to Forest type Composition on Forest scale if Alternative 2 is chosen**

	<b>MA 2B</b>		<b>MA 4A</b>		<b>MA 4B</b>		<b>MA 8A</b>
<b>Forest type</b>	<b>Post Cut</b>	<b>Desired</b>	<b>Post Cut</b>	<b>Desired</b>	<b>Post Cut</b>	<b>Desired</b>	<b>Post Cut</b>
<b>Aspen</b>	No Cumulative effects		24%	10-30%	21%	0-7%	No Cumulative effects
<b>Paper Birch</b>	1%	0-2%	No Cumulative effects		No Cumulative effects		No Cumulative effects
<b>Jack Pine</b>	No Cumulative effects		10%	0-35%	7%	3-6%	No Cumulative effects
<b>Red &amp; White Pine</b>	No Cumulative effects		31%	10-50%	26%	45-70%	No Cumulative effects
<b>Northern Hardwood</b>	54%	50-80%	7%	0-25%	12%	0-10%	No Cumulative effects
<b>Other species</b>	No Cumulative effects		1%	0-5%	1%	0-10%	No Cumulative effects

As you can see from the tables above there are still some areas where we need to change some of the forest composition. Even with all forest wide activities considered the composition forest wide only had change in 2 forest types in Management area 4B. Aspen and Paper Birch composition in management area 4B changed by 1% in each of these forest types. All other forest types in each of the other management areas changed less than 1% for cumulative effects or had no cumulative effects since there were no direct effects.

There are no cumulative affects based on age since age is only analyzed on a project level basis only leading to direct affects.

## Summary

### Degree to Which the Purpose and Need for Action is Met

To sum up this report it would be discussed which alternative best met each of the purpose and needs statements. Table 18 within the effects section of this document also showed how these needs were met it number formatting.

Need 1- There is a need to improve the stocking in a variety of overstocked forest types which would increase forest resiliency to insects, disease and fire.

This need was met the best by alternative 2 since it thinned out overstocked stand. Alternative 1 did not thin out any overstocked stands.

Need 2- There is a need improve the stand structure in even-aged and two-aged northern hardwoods and to maintain good stand structure in uneven-aged northern hardwoods while maintaining or enhancing within stand species diversity.

Alternative 2 also is the best option for meeting this need as well. Alternative 2 select harvested 5,169 acres converting many stands to 2 aged and uneven-aged stands. Alternative 1 converted no acres from even-aged to uneven aged.

Need 3- There is a need to modify the project area's age class distribution to more closely reflect Forest Plan desired future conditions.

Alternative 2 modifies many of the age class distributions in many forest types (please see Table 12. After treatment age class distribution in Fourmile project area). Alternative 1 is not a good option due to aging forest types these would degrade and not meet the need at all.

Need 4- There is a need to modify the project area's species composition to more closely reflect Forest Plan desired future conditions.

Alternative 2 changes many stands species composition. These changes better reflect what the Forest Plan lays out of what we should have in the district (please references Table 13). Alternative 1 would not change the forest composition at this time so it would not be a viable option.

Need 5- There is a need to continue experiments on the Argonne Experimental Forest and within the Eagle River Florence Ranger District.

Alternative 2 is the only alternative to allow studies to continue with the Argonne Experimental Forest on the Eagle River Florence District. Alternative 1 would allow these 100 year studies to be stopped before they have reached the timeframe the study was intended for.

Need 6-There is a need to satisfy timber demand

Alternative 2 better meets this need just in the fact that we are harvesting acres which would lead to timber being produced. Alternative 1 would not meet this need at all.

In summary to meet the most amount of needs to the fullest potential in a Silviculture stand point alternative 2 is the best option.

## Summary of Environmental Effects

Table 20. Comparison of proposed harvesting actions by alternative

Proposed Activity (acres)	Alt 1	Alt 2
Argonne Experimental Forest Study Cuts	0	526
Clearcut Harvest	0	209
Coppice Harvest	0	981
Improvement Harvest	0	263
Overstory Removal	0	205
Partial Overstory Removal	0	27

Proposed Activity (acres)	Alt 1	Alt 2
Precommercial Thinning	0	92
Restoration Harvests	0	186
Salvage Harvest	0	109
Sanitation Harvest	0	118
Selection Harvest	0	5169
Shelterwood Harvest	0	403
Commercial Thin	0	3411
Total Harvest Acres	0	11700

Table 21. Comparison of proposed reforestation actions by alternative

Activity	Alt 1	Alt 2
Aspen Site Preparation	0	966
Biochar Application	0	240
Burn	0	334
Manual Site Preparation (Canopy gaps)	0	5249
Full Plant or Underplanting	0	647
Mechanical Scarification (for natural Regeneration)	0	249
Mechanical Scarification (for artificial Regeneration)	0	103

## Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Both the action alternative and the no action alternative meet all Forest Plan regulations. Best management practices would be used on the action alternative

## Glossary

**Biochar**- soil amendment that is created by the heating of biomass in the complete or near absence of oxygen.

**Canopy Gaps** – a treatment that is used primarily in northern hardwood stands. Patches of non-merchantable trees are cut to create anywhere from a 25-60 foot gap in the canopy of the overstory trees.

This small patch, with no overstory, would be favorable to mid-tolerant species such as yellow birch and hemlock. The ultimate goal is to create a stand that has a high amount of species diversity.

**Clearcut** – even-aged harvest that removes all merchantable, and unmerchantable trees of all species, with the exception of a few reserve trees, mainly for wildlife purposes. There are usually about 2-5 live trees per acre left behind (CNNF Forest Plan 2-14). In general, this type of cut is used for overmature balsam fir stands, mature red pine, and jack pine stands. It is also primarily used for unhealthy spruce stands where mortality is high and a salvage is needed. Regeneration methods would vary in this type of cut based on the species composition.

**Commercial Thinning** – an intermediate cut designed to enhance the growth and quality of crop trees. This is the most common type of cut for red pine, white pine, and spruce stands. The high quality and healthy trees are usually left behind to serve as the crop trees while the suppressed and unhealthy trees are cut out from the stand. The number of crop trees left behind depends on size and spacing of the trees in the current stand.

**Coppice**- even-aged harvest that removes all merchantable, and unmerchantable trees of all species, with the exception of a few reserve trees, mainly for wildlife purposes. There are usually about 2-5 live trees per acre left behind (CNNF Forest Plan 2-14). The difference between a Coppice cut and a Clearcut is how the regeneration gets reestablished. A Coppice cut will be regenerated naturally through root suckering and sprouting.

**Harvest**- The commercial removal of trees to achieve stated objectives

**Improvement Cut** – an intermediate cut to develop uneven-age structure in an even-aged or two-aged stand. The most common use for this type of cut is when trying to convert a mature aspen stand into a northern hardwood stand. In this example, the high risk aspen are removed to promote the next succession of species, the hardwoods.

**Individual Tree Selection (selection cut)** – a regeneration cutting method where merchantable trees from different size classes and different species are selected to be harvested. This is the most common type of cut in northern hardwood stands in order to obtain the desired conditions of a multi-aged stand. It allows for increased sunlight to hit the forest floor and decreased competition for nutrients in the soil which should result in better hardwood regeneration.

**Overstory Removal** – this type of cut differs from a clearcut in that there is already an established understory of desired species. The overstory is removed and a new stand is created. This most commonly occurs in stands that have had preparation and seed cuts in the past as part of a shelterwood system, or in aspen/spruce/fir mixed stands where the overstory is high risk and an understory has developed on its own.

**Partial Overstory Removal**- The overstory is mostly removed to allow a new stand of already established regeneration to be released. Select species or groups of trees will remain in place to give species diversity and to allow for some legacy trees from the old stand.

**Precommercial Thinning**- an intermediate cut/ removal of trees to enhance growth and quality of crop trees that will not earn immediate financial return.

**Reserve Island**- In even-aged managed areas, variable sized reserve islands are created that total up to ½ acre for every 10 acres managed. To emphasize diversity and/or mast trees, tree species such as hemlock, cedar, white pine, red oak, ironwood and yellow birch are included in these islands (Forest Plan 2-14).

**Restoration/ Restoration Thin**- a commercial harvest in a previously planted stand ( or near previously planted stands) which lowers the basal area of the stand to a much lower level to allow for the

reintroduction of fire. A reintroduction of fire is crucial in these stands because they have strayed so far from their historical condition. By introducing fire we are encouraging the stands to return to historical conditions not just in tree species but also in other plant species.

**Salmon Blading** – a treatment that is used to scarify the ground to create a better seed bed for mid-tolerant species such as red oak, yellow birch, and hemlock. The blade is usually attached to a dozer and would remove all non-woody as well as some smaller woody vegetation along the forest floor. The result would be exposed bare mineral soil for the seed crop. This treatment can be done within canopy gaps or on the entire stand.

**Salvage**- the removal of trees damaged by insect, disease, or natural causes such as high winds. The forest in recent years experienced a decline in white spruce stands due to a combination of spruce budworm, a needle drop fungus, drought conditions and root rot. Once the crowns of these trees become too thin or the percentage of live crown is reduced too far (less than 33%) or mortality gets too high (>10%), a salvage harvest has been used to remove and utilize the trees.

**Shelterwood** – this is a multistage approach that usually involves a preparation cut, a seed cut, and a removal cut. The preparation cut is to condition the stand for a future seed cut. The seed cut is a regeneration harvest to obtain natural regeneration by seeding from leave trees and by providing shade from leave trees. The seed cut retains enough trees to provide about 20-50% shade on the ground. The removal cut is a harvest to remove the overstory from an area regenerated by the preparation and seed cuts. A shelterwood is most commonly used in paper birch stands, but can also be used in white pine, northern hardwood, and aspen stands.

**Site Preparation/Disk Trench** – a treatment that usually occurs after a stand has been clearcut and is planned to be planted in the near future. There are several different methods of site preparation including burning, roller chopping (mechanical), and by chainsaw/brush saw (manual). The stand is then usually disk trenched, which is a machine that disturbs the soil and creates rows of holes, making it much easier to plant the seedlings. The objective is to not only eliminate all of the unwanted competition, but to prepare the soil before the seedlings are put into the ground to ensure the best possible survival of the seedlings.

**Timber Stand Improvement (Release)** – a treatment that is used to improve the growth and quality of desired vegetation at the non-merchantable seedling/sapling level. Unwanted species are cut to reduce the competition of desired species. This can be done either as an area release or an individual tree release. For an area release, all unwanted seedlings/saplings in the entire stand are cut. For an individual tree release, only the unwanted vegetation directly affecting the desired vegetation is cut (for example: a cleared out circle with a 4 foot radius around each planted seedling).

**Underplanting**- Trees are planted under the existing overstory which serves as a shelterwood to protect the planted trees until they become established

**Understory Burn** – usually a low intensity burn that is used to eliminate unwanted species that are outcompeting and inhibiting the growth of desired species. This type of treatment is most commonly used in oak and paper birch typed stands since these species respond well after fire.

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